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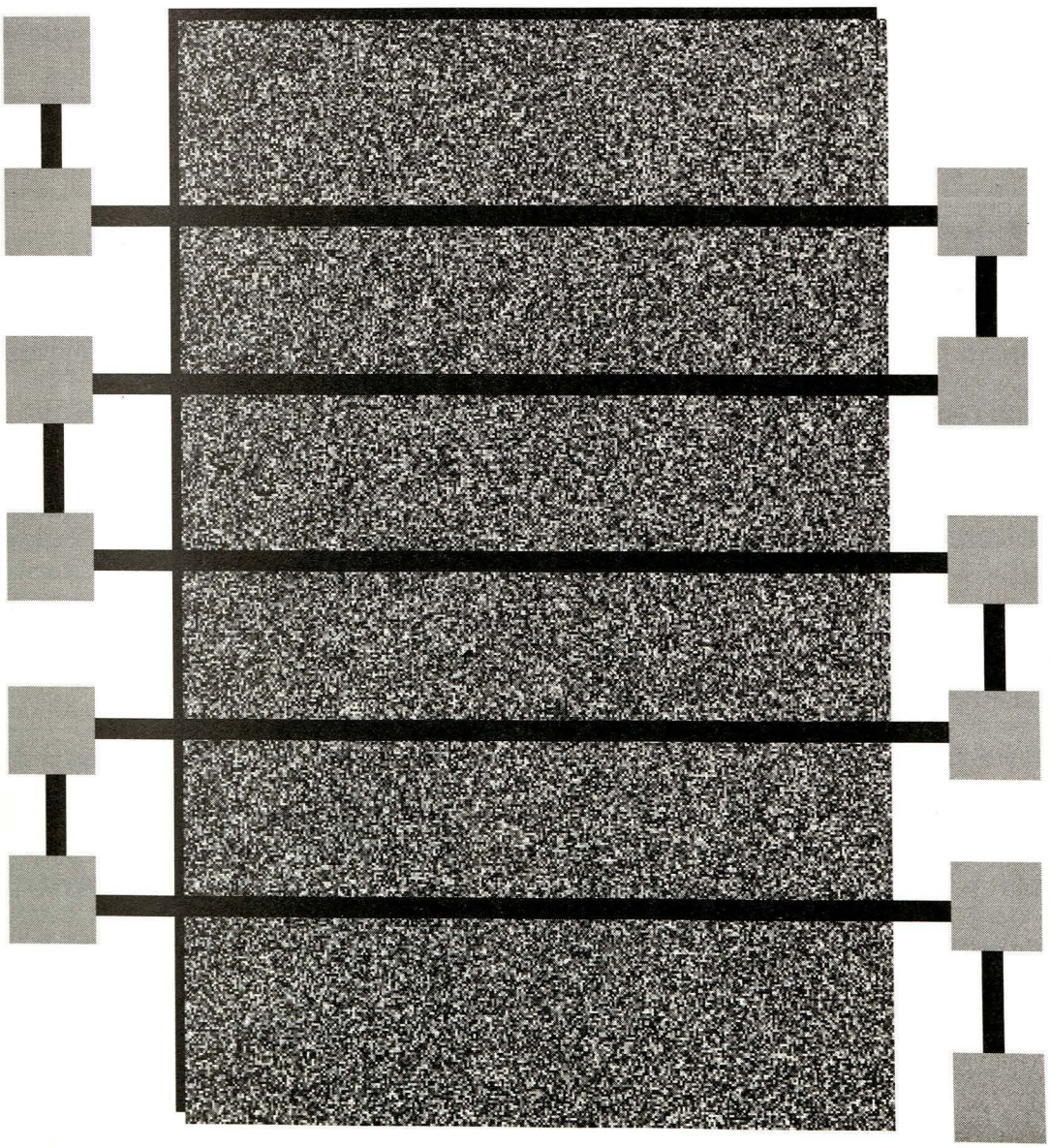
Regional Impacts of Technical Change: The Case of Structural Particleboard in the United States

Zhi Xu, David N. Bengston, Hans M. Gregersen and Allen L. Lundgren



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Analyzes the regional impacts of research benefits in the United States due to the introduction of structural particleboard. The distribution of consumer benefits, producer benefits, direct employment impacts, and changes in wood requirements are analyzed for the four census regions. The distribution of benefits is found to differ widely between regions, indicating the need to evaluate the distributional impacts of new technologies.

KEY WORDS: Structural particleboard, technical change, distributional impacts.

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Regional Impacts of Technical Change: The Case of Structural Particleboard in the United States

Zhi Xu, David N. Bengston, Hans M. Gregersen, and Allen L. Lundgren

The important role of technical change—or change in the techniques of production—in the process of economic growth and development has long been recognized. Empirical research on the economic impacts of technical change began in the 1950's. Early studies examined the contribution of technical change to aggregate economic growth, and they concluded that technical change, rather than increases in capital and labor, was primarily responsible for economic growth in the long run (Stier and Bengston 1992, and studies cited therein).

Economists then began to examine the sources of technical change and their individual contributions to economic growth. Investment in public and private research is a major source of technical change that has received much attention. Economic impact studies of the relationship between research and technical change have concentrated on the agricultural sector. Early studies of this type in agriculture were carried out by Griliches (1958), Peterson (1967), and Grossfield and Heath (1966). The same basic methodological framework has been used in forestry research (Jakes and Risbrudt 1988, and studies cited therein).

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However, few studies of technical change and research impacts have focused on the equity or distributional impacts. In addition to economic efficiency impacts, technical change also entails distributional consequences: Some groups within society will be made better off as a result of the development and adoption of a major new technology, while others could be made worse off. For example, decades of rapid technical change in U.S. agriculture—brought about in part by public investment in agricultural research—have resulted in difficult adjustments for small producers and farm workers. Agricultural research policy makers have been accused of giving insufficient attention to these distributional impacts, and the University of California has been ordered by the California Superior Court to evaluate the social costs to small farmers of its agricultural research (Sun 1987). The heavy involvement and influence of the public sector in forestry suggest that assessment of the distributional impacts of research and technical change in the forest-based sector may have important implications for public policy.

Most previous studies of the distribution of benefits from research and technical change have been concerned mainly with the distribution of gains between producers and consumers (*e.g.*, Ayer and Schuh 1972, Schmitz and Seckler 1970, Akino and Hayami 1975). Other studies have examined the distribution of research benefits among income groups (Scobie and Posada 1978). We conducted a study to analyze the regional distribution of research benefits in the U.S. due to the introduction of structural particleboard (SPB). Structural particleboard, a reconstituted

wood panel made with exterior grade resins, has properties suitable for structural and exterior applications. It can be substituted for construction-grade plywood for most uses, and includes both waferboard and oriented strandboard. We chose structural particleboard technology as a case study because it is a major innovation in forest products with significant public sector involvement throughout its development (Haygreen *et al.* 1985, Bengston *et al.* 1988). The introduction of SPB, which involved a large investment in public and private research, has generated significant economic benefits. The average internal rate of return to SPB research investment was estimated by Bengston (1984) to be about 20 percent. Although the benefits have been significant overall, the distribution of benefits differs widely between regions.

FRAMEWORK, DATA, AND METHODS

This study examines the impacts of technical change in the four census regions of the United States: Northeast (NE), North Central (NC), South (SO), and West (WE) (fig. 1). The introduction of SPB technology has created both direct and indirect impacts among the regions. Data availability is an important constraint in measuring many of these impacts. In this study, we analyzed consumer benefits, producer benefits, direct employment impacts, and wood requirements. In addition, trade impacts (imports of SPB) were analyzed as a factor influencing producer benefits. Many secondary impacts were ignored due to lack of data. The impact of SPB technology on wood requirements was only partially analyzed for two regions.

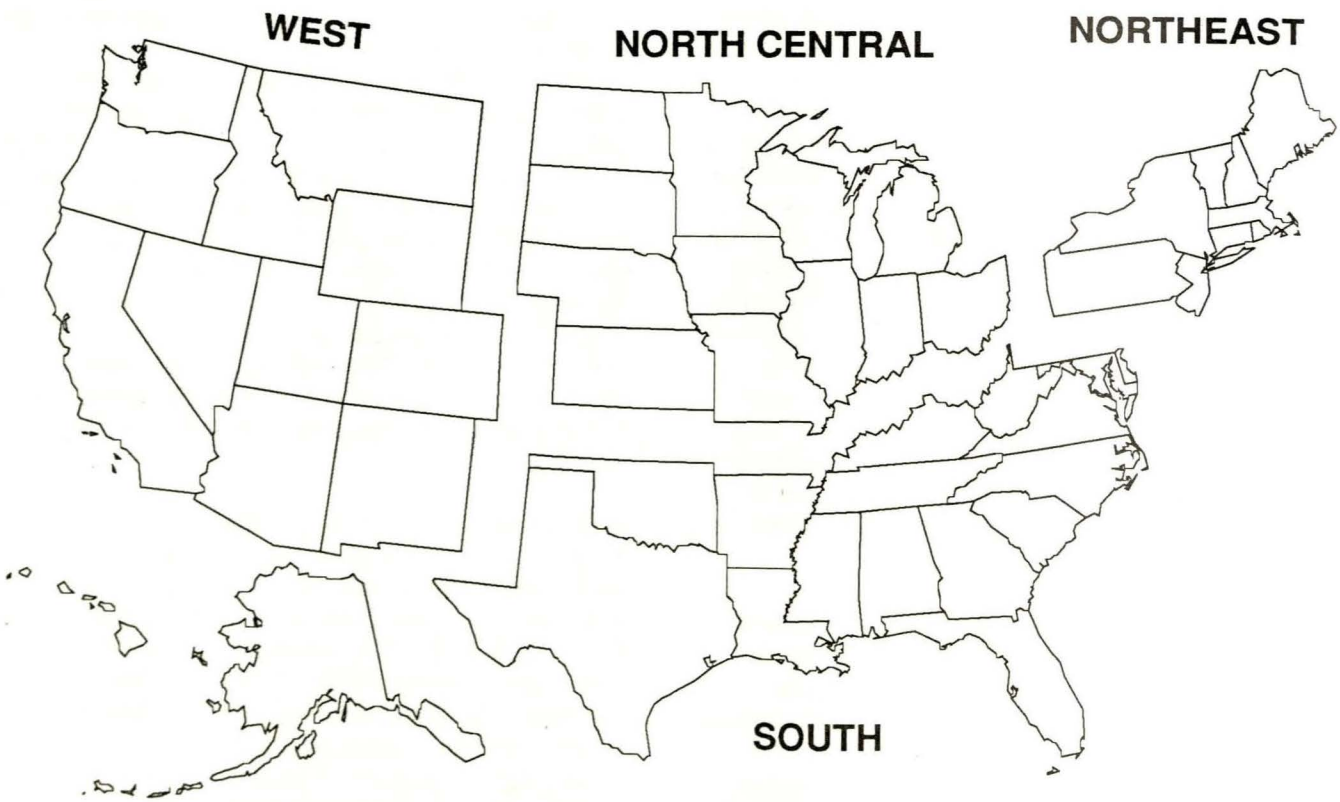

Figure 1.—*Census regions of the United States.*

Indicators of Distributional Impacts and Data Sources

Consumer Benefits

Consumer surplus is used in this study as an indicator of consumer benefits.[1] To measure consumer surplus, we assume SPB consumption to be a substitute for plywood consumption. We estimated consumer surplus with a regionalized version of the model used by Bengston (1984), measuring consumer benefits due to the price difference between SPB and construction grade plywood, and the consumption of SPB in each region. Total consumer benefit for each region is given by:

$$CB = (P_{PLY} - P_{SPB})Q_{SPB} - \frac{1}{2}(K*n*Q_{SPB}(P_{PLY} - P_{SPB}))$$

$$= (P_{PLY} - P_{SPB})Q_{SPB}\left(1 - \frac{1}{2} * K * n\right)$$

where:

- CB = annual consumer benefit in dollars due to introduction of SPB for each region.
- P_{PLY} = regional average delivered price of construction grade plywood, $/thousand square feet (MSF), 3/8 inch basis (Source: DRI 1984b).
- P_{SPB} = regional average delivered price of SPB ($/MSF), 3/8 inch basis (Source: DRI 1984b).
- Q_{SPB} = regional consumption of SPB (MSF), 3/8 inch basis (Source: DRI 1984b).
- K = percentage difference in regional SPB price compared to regional plywood price, *i.e.*,

$$K = \frac{P_{PLY} - P_{SPB}}{P_{PLY}}$$

- n = the absolute value of the price elasticity of demand for structural wood panel by region (Source: Adams and Haynes 1980).

Note that because of the way in which K is calculated—based on the price difference between SPB and plywood—consumer benefits will be understated somewhat. Plywood prices would likely be higher without SPB due to a less competitive structural panel market.

Producer Benefits

Ideally, producer benefits should be measured by estimating producer surplus, parallel to the estimation of consumer benefits. But lack of data on the price elasticity of supply and other variables made it impossible to measure producer surplus directly in this study. Therefore, measures of changes in structural panel production over time by region are used as an approximation of producers' gains and losses by region. This method implicitly assumes the same profit margin for plywood and SPB production. In fact, there is some evidence that SPB had a higher profit margin than plywood in the early stages of market development (DRI 1984a). As a result of this assumption, the measure of producer benefits tends to overstate the effect of plywood and understate the effect of SPB. In spite of this shortcoming, the method gives a rough estimation of producer benefits by region. Regional production of SPB has been estimated by multiplying SPB capacity by its demand/capacity ratio, *i.e.*,

$$PROD_{SPB} = CAP_{SPB} * R_{SPB}$$

where:

- $PROD_{SPB}$ = estimated regional SPB production, billion square feet (BSF).
- CAP_{SPB} = regional SPB capacity (BSF) (Source: DRI 1984b).
- R_{SPB} = demand/capacity ratio (Source: DRI 1984b).

The impacts of imports were also analyzed in this study as a factor influencing producer benefits. Although imports of SPB currently represent a small share of total structural wood panel consumption in the United States, they have been increasing and accounted for a significant share of consumption of SPB in the early years of market development. Canadian SPB entered the U.S. market early, and the gap between U.S. SPB consumption and production has increased; U.S. producers have been losing part of the national market for SPB. SPB imports were estimated as the total consumption of SPB minus total production of SPB.

[1] *See Currie* et al. *(1971) for a good discussion of the development and use of consumer and producer surplus in economic analysis.*

Employment Impacts

The numbers of jobs created by SPB production and lost in plywood production are the indicators of direct employment impacts. Employment was estimated from person-years of employment, calculated from total hours of employment based on the assumption that a laborer works 8 hours a day, 5 days a week for 48 weeks (a total of 1,920 hours per year). Total hours of employment generated per year are estimated by multiplying the quantity of production (MSF) by labor productivity (hours/MSF). As with the preceding indicator, production is estimated by multiplying regional mill capacity by a reported demand/capacity ratio, which is assumed to be equivalent to the utilization of capacity. Labor productivity for SPB is reported in FORSIM (DRI 1984b), and the labor productivity for plywood is developed from data on labor costs per MSF and from unit wages. Thus, employment impacts are calculated as follows:

$$E_{SPB} = (PROD_{SPB} / LP_{SPB}) / 1{,}920$$

$$E_{PLY} = (PROD_{PLY} / LP_{PLY}) / 1{,}920$$

where:

E_{SPB} = estimated regional employment provided by SPB production (number of person-years of employment).

E_{PLY} = estimated regional employment provided by plywood production (number of person-years of employment).

$PROD_{SPB}$ = regional SPB production (MSF) (Source: DRI 1984b).

$PROD_{PLY}$ = estimated regional plywood production (MSF) (Source: DRI 1984b).

LP_{SPB} = reported labor productivity of SPB (hours/MSF) (Source: DRI 1984b).

LP_{PLY} = estimated labor productivity of plywood, *i.e.*,

$$LP_{PLY} = C_{PLY} / W_{PLY}$$

where:

C_{PLY} = regional labor cost per thousand square feet plywood (Source: DRI 1984b).

W_{PLY} = average unit wage for plywood worker ($/hour) (Source: DRI 1984b).

Wood Requirements

Another regional impact from introducing SPB is the opportunity to increase wood sales for local producers (loggers and growers). Because there was no structural wood panel production in the NC and NE regions before the introduction of SPB, the production of SPB can lead to expanded wood sales for local producers in these regions. This wood requirement also reflects an increasing use of regional forest resources. The indicator used is volume of wood. Secondary producer benefits and employment impacts depend on the capability of local wood producers to compete in the market. Because of geographic advantage, local producers are usually competitive. Wood requirements for the NC and NE regions were estimated based on the wood input rate per MSF and the production of SPB, *i.e.*,

$$WR_{SPB} = PROD_{SPB} * r / 1{,}000{,}000$$

where:

WR_{SPB} = regional wood requirement for SPB production (million cords).

$PROD_{SPB}$ = regional SPB production (MSF) (Source: DRI 1984b).

r = wood input rate or conversion rate (cords/MSF) (Source: DRI 1984b).

Data

Primary data were obtained from DRI-FORSIM reports (DRI 1984a, b). The data after 1984 are from forecasts obtained through FORSIM models. Calculations in this study were mainly based on FORSIM data to keep the calculations consistent and comparable among regions and over time. A survey conducted by Random Lengths (1989) indicates that actual U.S. SPB production in 1987 and 1988 was close to the forecast data generated by FORSIM. The demand elasticities by regions, used to estimate consumer surplus, were obtained from Adams and Haynes (1980). Elasticities are assumed to be constant over time—although they should have declining trends according to Spelter (1984)—because there is no reliable approach for breaking the trends down by region. Because price fluctuations may affect the comparisons of results over time, we applied a 3-year moving average to all final calculations.

Therefore, data used for the analysis are the average of the current year, the preceding year, and the next year if no explanation is attached. All calculations were made for the period 1976 to 2000. Four years (1980, 1985, 1990, and 1995) were used in the figures as representative years.

RESULTS AND ANALYSIS

Consumer Benefits

Figure 2a shows total consumer benefits by region from 1976 to 1999. Total consumer benefits are positive in all years except for 1976 to 1979 for the NC and NE, and 1976 to 1980 for the SO and WE. Negative values in those years are due to higher SPB prices relative to plywood, a result of limited U.S. SPB production, high transportation costs for imported SPB, and relatively low plywood prices in these regions. After 1980, the price of plywood became higher than that of SPB, and consumer benefits for all regions steadily increased.

The size of consumer benefits for each region depends on both the quantity of SPB consumed and the difference between prices of SPB and plywood. Before 1985, the NC and NE together accounted for 70 percent or more of total consumer benefits, although total consumption of SPB was relatively small. Even after 1985, consumer benefits in both regions still account for between 60 and 70 percent of the total consumer benefit in all regions, which is larger than their share of consumption of SPB (table 1, fig. 2b).

Three factors explain this effect. First, because very little construction grade plywood is produced in the NC and NE regions, almost all of the plywood consumed is imported from other regions and usually has a relatively high price due to transportation costs. Second, SPB produced locally has a lower price due to a lower transportation cost and lower input cost for wood such as aspen. Therefore, the price differences are larger than those in other regions. Lastly, in the early period, the proportion of SPB imported from Canada was significant. The NC and NE regions imported more Canadian SPB due to their proximity to Canadian producers.

Although consumer benefits in the SO make up only a small share of national consumer benefits in the early decade, they are rising most rapidly. The SO will lead all other regions in total consumer benefits after 1995 (fig. 2a). This is due to two factors. First, although SPB as a pecentage of total structural panel consumption is smaller for the SO than for the NE and NC, the SO consumes more SPB than the NC and NE because of this region's higher total consumption of all structural panels. Second, the rapid increase of

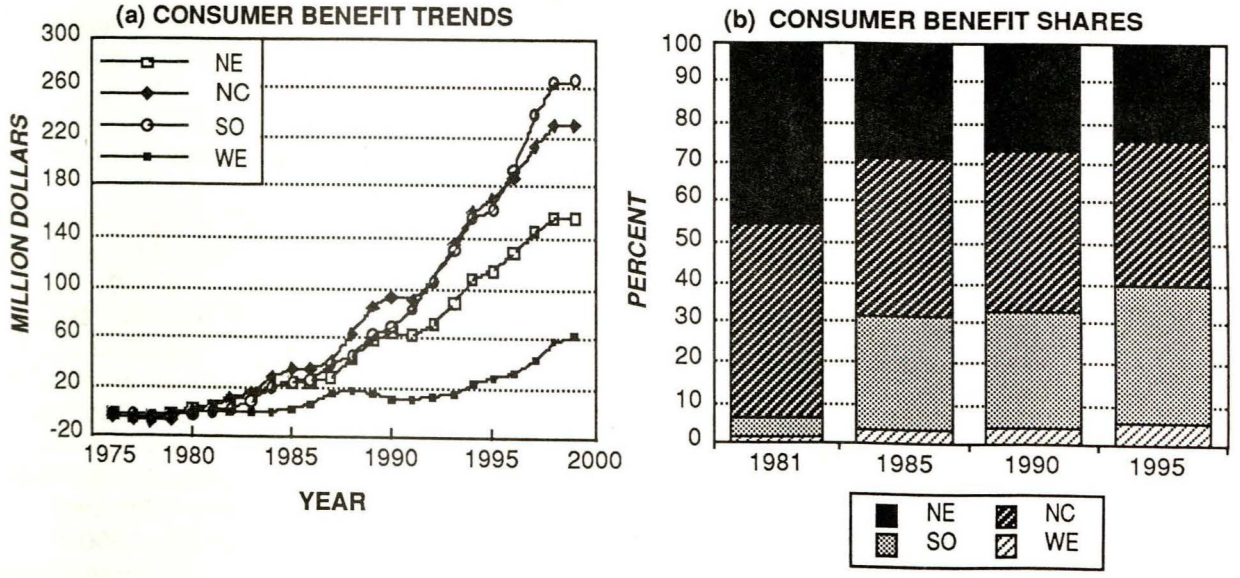

Figure 2.—*Structural particleboard consumer benefit trends and shares.*

Table 1.—*Consumer benefits, production, and employment impacts resulting from the introduction of SPB, selected years*

Region	Impact type[1]	1980 Impact[1]	1980 Percent of total	1985 Impact[1]	1985 Percent of total	1990 Impact[1]	1990 Percent of total	1995 Impact[1]	1995 Percent of total
NE	CB	3,120	53.33	24,720	28.65	63,140	26.88	114,550	24.06
	PROD	17	0.09	460	2.22	973	4.64	1,520	7.22
	EM	17	0.03	420	0.73	830	1.75	1,197	3.06
NC	CB	1,800	30.77	34,750	40.28	93,310	39.73	171,180	35.96
	PROD	180	1.00	1,110	5.35	1,603	7.64	2,007	9.53
	EM	173	0.26	1,020	1.77	1,370	2.90	1,583	4.05
SO	CB	627	10.72	23,360	27.07	67,810	28.87	162,070	34.05
	PROD	9,197	51.01	10,497	50.57	10,173	48.48	10,353	49.14
	EM	27,423	41.76	26,570	45.98	20,880	44.13	18,207	46.61
WE	CB	-303	-5.18	3,450	4.00	10,620	4.52	28,240	5.93
	PROD	8,637	47.90	8,690	41.87	8,233	39.24	7,187	34.11
	EM	38,060	57.95	29,777	51.53	24,240	51.23	18,077	46.28
TOTAL	CB	5,850	100.00	86,280	100.00	234,880	100.00	476,040	100.00
	PROD	18,030	100.00	20,757	100.00	20,983	100.00	21,067	100.00
	EM	65,674	100.00	57,787	100.00	47,320	100.00	39,064	100.00

[1] Impact types and units are as follows: CB (consumer benefits, thousands of dollars), PROD (structural panel production, million square feet, 3/8 inch basis), EM (employment in the structural panel industry, number of jobs).

SPB production in the SO assures the rapid increase of SPB consumption at lower local cost. Consumption and production of SPB in the SO are almost equal and both of them increase rapidly, indicating that the region is roughly self-sufficient in SPB.

Compared with other regions, consumers in the WE gain the least mainly because of the more competitive price of plywood, which results in the following impacts. First, SPB consumption in the WE rises much more slowly than in the other regions, but plywood consumption is almost constant there over time compared to sharp declines in the other regions. Second, the price difference between SPB and plywood is smaller in the WE than in other regions (DRI 1984b). Thus, the two main factors affecting consumer benefits are smaller in the WE than in other regions. In recent years, high timber prices in the WE have likely increased consumer gains from SPB in this region.

Producer Benefits

Producer impacts among regions are estimated by the redistribution of total structural wood panel production after the introduction of SPB. The first impact on producers to be analyzed is the import effect. Before 1976, the import of structural wood panels was small enough in total U.S. structural wood panel consumption to be ignored. However, as SPB consumption in the U.S. increased, imports of SPB from Canada have also increased steadily. Importation of SPB from Canada increased rapidly in the late 1980's (Random Lengths 1989) to meet the rapid expansion in U.S. SPB demand. However, a more

competitive U.S. market in the late 1990's will likely slow Canadian penetration, and the increase in SPB imported from Canada will eventually level off. Total structural wood panel production is projected to rise from 18.03 BSF in 1980 to 21.07 BSF in 1995, while total structural wood panel consumption is projected to rise from 17.91 to 22.69 BSF over the same period (fig. 3). Meanwhile, SPB production during this period will increase from 0.32 to 8.63 BSF and plywood production will decline from 17.71 BSF to 12.44 BSF.

Figure 4 shows the net flows of structural panel by type (SPB and plywood) in 1980 and 1995. To maintain balance, a 3-year moving average is not applied to the flows in this figure.[2] Increasing SPB production in the NC and NE leads to reductions of plywood flowing into the two regions, which accounts for the reduction in plywood exported from the SO and WE. In 1980, the SO and WE shipped 5.82 BSF of plywood into the NC and NE. But by 1995, the amount shipped is forecast to decrease to 2.20 BSF. For SPB, the WE and SO can be viewed as roughly self-sufficient while the NC and NE need to import SPB in addition to their own production to meet excess demands. But the imports come increasingly from Canada rather than the WE or SO. The WE and SO lose market share because their gains from SPB cannot compensate their losses in plywood.

Plywood producers in the SO lose a relatively small portion of their market share. Although plywood production has been declining rapidly, the decrease in plywood exports will not be significant, dropping from 2.46 BSF in 1980 to 2.09 in 1995 (fig. 4). For total structural panel production, the SO's market share is projected to decrease from 51.01 percent in 1980 to 49.14 percent in 1995, an insignificant change. Plywood producers in the WE lose much more than those in the SO. Their share of the total structural panel market will decline from 47.90 to 34.11 percent in the same period, a loss of 14 percent of the U.S. market (table 1).

[2] *Note that figure 4 omits imports of plywood and exports of SPB.*

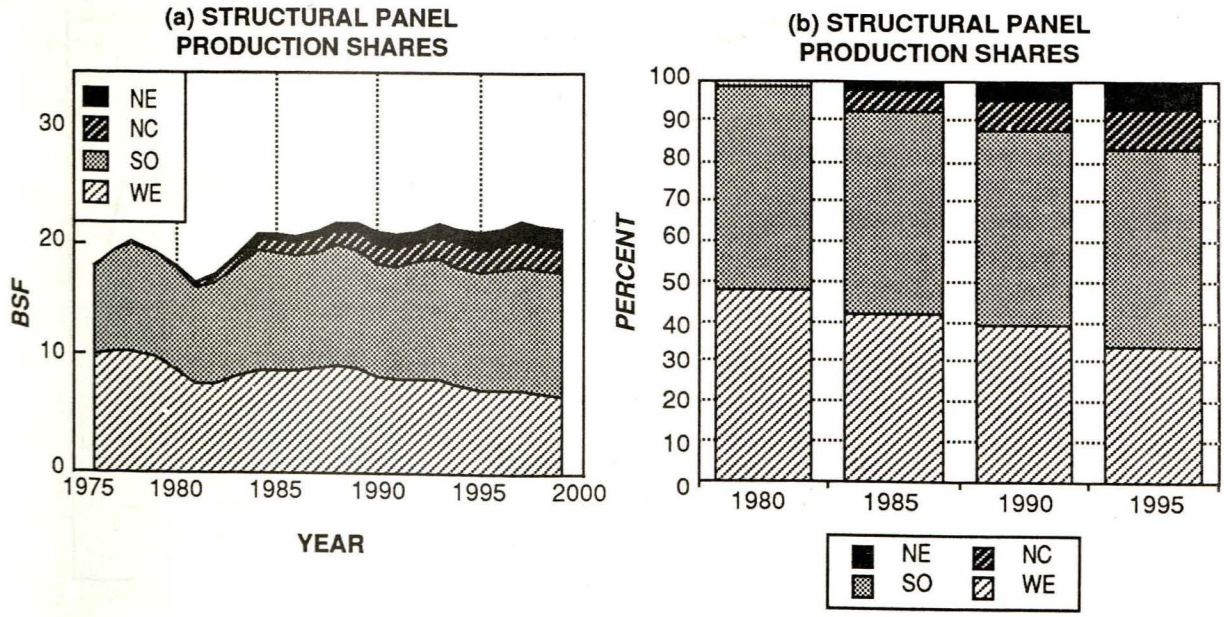

Figure 3.—*Structural panel production trends and shares.*

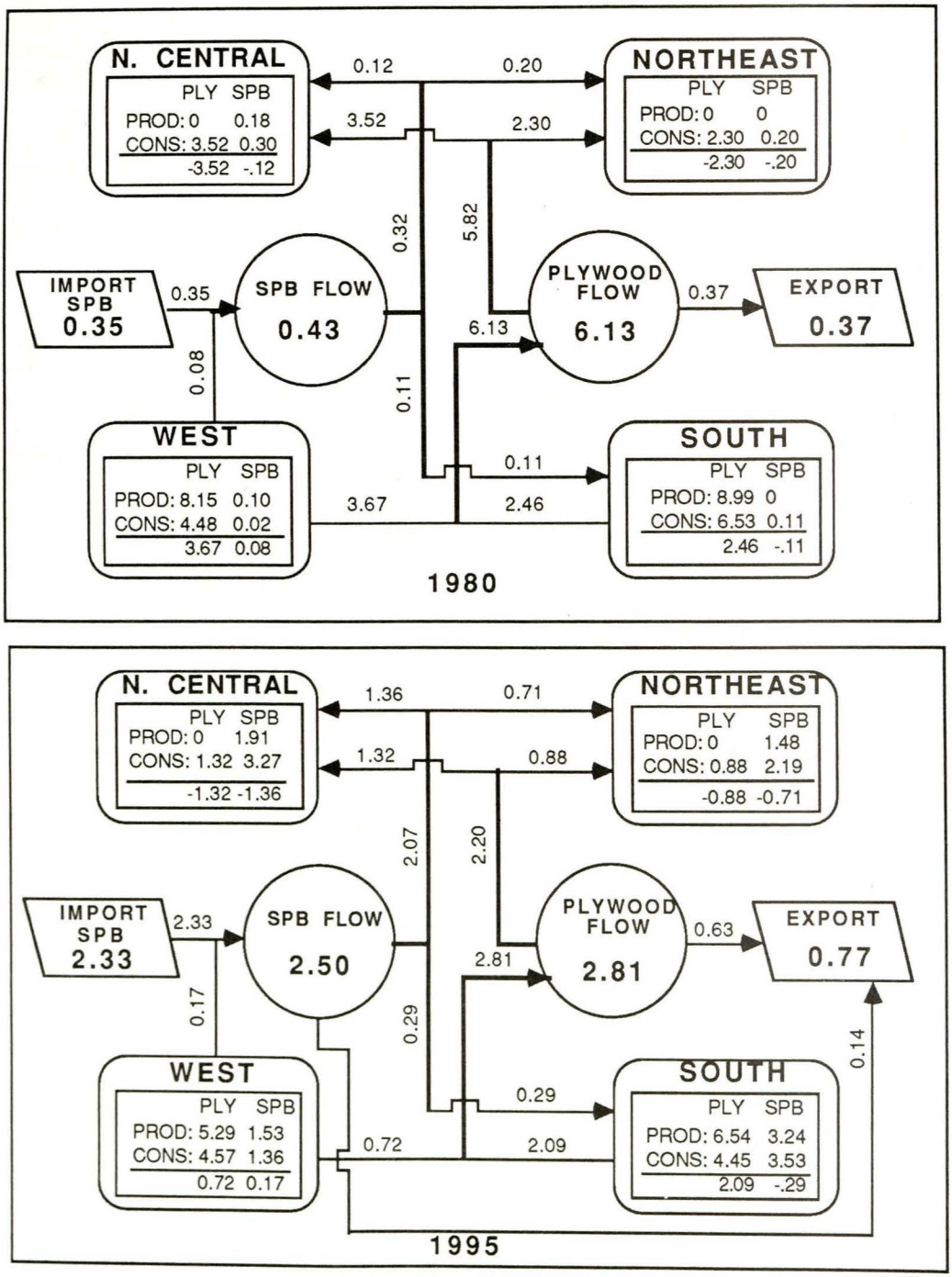

Figure 4.—*Change in structural panel flows among regions as a result of the introduction of SPB, 1980 and 1995 (BSF).*

Three factors help explain why the WE loses market share. First is that the WE exports more plywood to the NE and NC than does the SO. When the NE and NC produce SPB locally and reduce imports of plywood, the WE loses more than the SO because of its larger export share. Thus, there is a greater impact in the WE from the shrinking plywood market. Another reason is that the plywood produced and shipped from the SO has a lower price than that from the WE and the price differential is increasing over time. Therefore, in confronting the reduction in demand for plywood, the SO is more competitive than the WE. Finally, because plywood is competitive with SPB in the structural panel market in the WE, there is some SPB exported from the WE, although it is a small amount.

In contrast to the SO and WE, producers in the NC and NE gain from the introduction of SPB because no plywood is produced in these regions. SPB is more competitive there than plywood because of cheaper wood resources, lower labor cost, and lower transportation cost. The structural panel market share of NC producers will increase from 1 percent in 1980 to 9.53 percent in 1995. In the NE, the market share will increase from nothing in 1980 to 7.22 percent in 1995 (table 1).[3]

[3] *The small amount (17 million square feet) of SPB produced in the NE in 1980 is due to the calculation of 3-year averages. In fact, there was no SPB produced in the NE in 1980.*

Employment Impacts

Figures 5a and 5b provide a summary of the employment impacts resulting from the introduction of SPB. In general, employment in the structural panel industry tends to decline over time. There are three reasons for this decline. First, labor productivities for both plywood and SPB increase over time, which would produce a declining trend if production is held constant. Second, because SPB production is labor-saving relative to plywood, the substitution of SPB production for plywood reduces labor requirements. According to FORSIM data (DRI 1984b), SPB requires only about one-third of the labor input for each unit of production compared to plywood. Therefore, although SPB production rises rapidly, the employment generated rises slowly. For example, the production share of SPB will increase by about 40 percent from 1980 to 1995, while the employment share will increase only by about 17 percent. SPB will account for 45 percent of structural wood panel production in 1995, but will generate only 17 percent of the employment. Third, because of increased imports of SPB from Canada, domestic producers will lose market share, resulting in a loss of domestic employment. Consequently, although total production will increase from 18.03 BSF to 21.07 BSF during 1980 to 1995 (which has a positive impact on employment), employment will still drop from 65,674 in 1980 to 39,064 in 1995 (table 1).

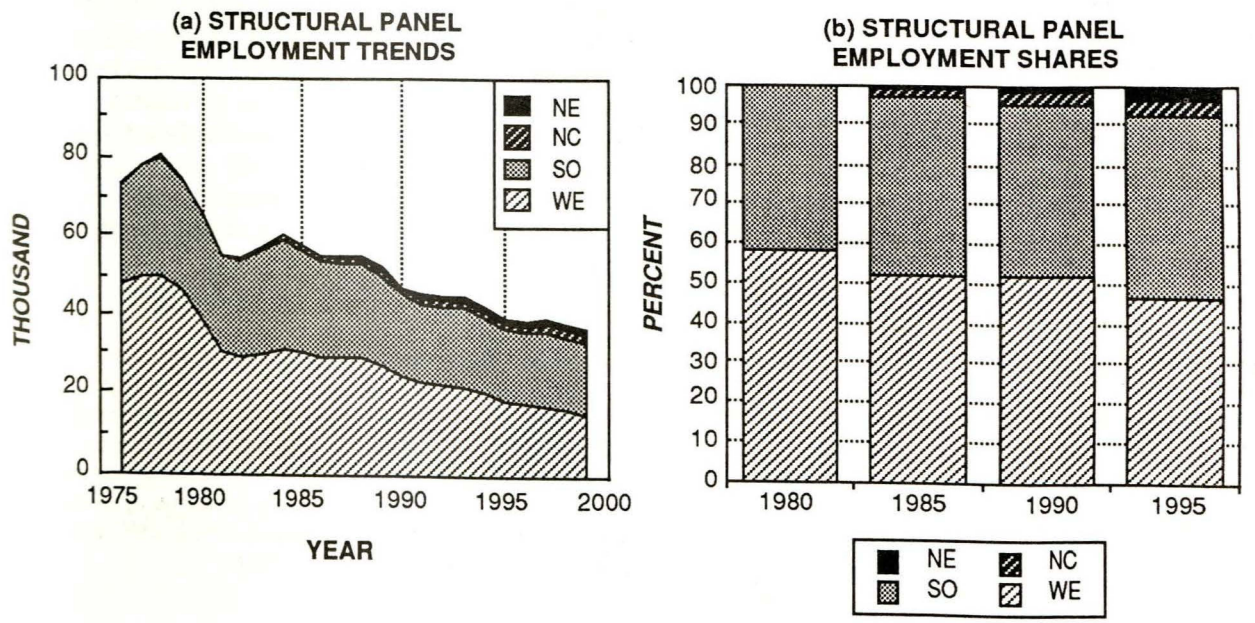

Figure 5.—*Structural panel employment trends and shares.*

However, it is important to distinguish between the employment impact of an increase in labor productivity and the employment impact due to the introduction of SPB. According to calculations based on FORSIM data (DRI 1984b), the labor hours needed to produce an MSF of plywood were 5.57 for the SO and 8.44 for WE in 1980. They are projected to decrease to 4.34 for the SO and 5.75 for the WE by 1995. These increases in the labor productivity of plywood production lead to a reduction in total employment in the structural panel industry. If production for both regions stayed constant at 1980 levels, by 1995 the increase in labor productivity for plywood production would result in a loss of 6,052 jobs in the SO and a loss of 12,098 jobs in the WE.

Regional impacts are not always consistent with the general trend, however, because of regional differences in panel production by type. Because no plywood is produced in the NC and NE, SPB production generates employment at the expense of employment lost from a reduction of plywood production in other regions. Because SPB production increases faster than labor productivity, employment in the NC and NE rises over time. Total employment generated by SPB during 1980 to 1995 will increase from 173 jobs to 1,583 jobs for the NC, and from 0 to 1,197 for the NE. In contrast, employment in the structural panel industry in the same period will decrease from 27,423 jobs to 18,207 jobs in the SO, and from 38,060 to 18,077 jobs in the WE (table 1).[4] If we take out the number of jobs lost through increasing labor productivity, the job losses resulting from the introduction of SPB are 3,164 in the SO and 7,885 in the WE during 1980 to 1995 (fig. 7c).

Overall, substantial declines in employment are projected for the structural panel industry. Total employment in the structural panel industry for the entire country will decline from 65,674 in 1980 to 39,064 in 1995, a decline of about 40 percent over 15 years. About one-third of this decline is caused by the introduction of SPB. The rest results from the increase in labor productivity in plywood production that is related to the introduction of SPB.[5] The loss of jobs resulting from shrinking plywood production cannot be offset by jobs created by increasing SPB production. Although the SO and WE lose a large amount of employment, the NC and NE gain only a small amount.

Wood Requirements

Figure 6 shows the changing wood requirements for the NC and NE regions. The wood required for SPB production will increase from 0.137 million cords in 1980 to 1.644 million cords in 1995 for the NC, and from 0.013 to 1.343 million cords for the NE in the same period. These wood requirements can be used to provide a rough estimate of the total acreage of forest land required to meet the increased demand for industrial wood from either private or public land.

SUMMARY OF REGIONAL IMPACTS

Figures 7a through 7d provide profiles of changes in regional impacts resulting from the introduction of SPB. These figures compare two points in time. The year 1980 was selected as the base year, when production and consumption of SPB were insignificant relative to the total structural wood panel market. The year 1995 was taken as the contrasting point in time when SPB is well established. Consumer benefits and shifts in production are calculated as the projected 1995 values minus the 1980 values by region. Changes in employment are calculated similarly for the NE and NC. For the SO and WE, jobs lost due to increased labor productivity in plywood production are factored in to obtain the total employment impacts due to SPB.

[4] *Other studies have found similar results regarding the employment impacts of technical change in the forest products industries in the WE particularly the Pacific Northwest (Lange* et al. *1989, Rufolo et al. 1988).*

[5] *"It has been observed that an established technique improves radically when confronted with the prospect of being supplanted by a new technique" (Sahal 1981: 79). Thus, in response to SPB, the plywood industry "is vigorously pursuing a sustained research effort to develop advanced forms of other exterior grade composite products which will be fully competitive" (McFarlane 1981: 317).*

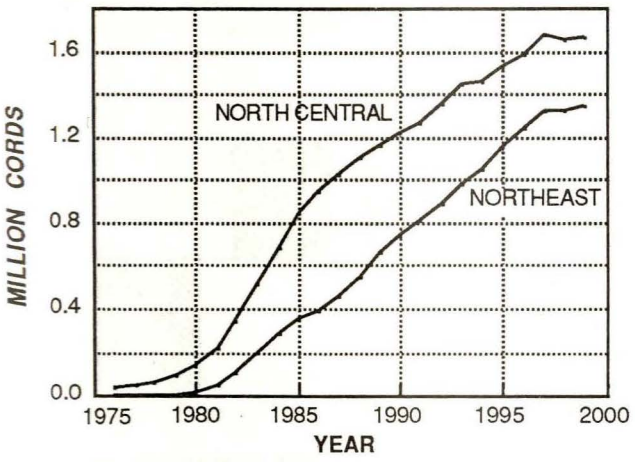

Figure 6.—*Wood requirements for SPB production in the NE and NC regions (million cords per year).*

All four regions gain consumer benefits. The NC region gains the most with a share of 36 percent, while the WE gains the least with a share of only 6 percent (fig. 7a). For producer benefits, all regions are gainers except the WE (fig. 7b). The net gains of producers in other regions offset the loss of production in the WE, however, resulting in a positive production impact in the structural panel industry for the country as a whole. For employment, the situation is quite different (fig. 7c). The WE and SO lose employment and the NE and NC gain employment, but the gain is much smaller than the loss in the SO and WE. In general, the introduction of SPB has a negative impact on national employment in the structural wood panel industry. The NC and NE regions gain with respect to all three impacts (fig. 7d). The SO gains consumer and producer benefits, but loses employment. The WE gains little in consumer benefits and loses significantly in production and employment.

CONCLUDING REMARKS

Technical change significantly affects the well-being of consumers, producers, workers, and the growth of national and regional economies. This paper has focused on certain regional impacts resulting from the introduction of structural particleboard. As a technical advance, SPB has produced sizeable economic efficiency benefits to society as a whole. But these benefits have not been shared equally—the distribution of benefits differs widely between regions.

Like many major innovations in forest products, public sector research played an important role in the development of SPB technology. This raises the question of the appropriate role of the public sector when some groups gain and others lose as a result of a particular technological innovation. It is clear that all of those involved in public research decision making—from top policy makers to scientists—need to become more aware of the distributional impacts of technical change. Distributional analysis should be included in evaluations of public research programs and major technological innovations so that policies can be developed to ease the dislocations caused by technical change.

Hayter (1988) has argued that the rate of technical change in the forest products industries has increased over the past 20 years. The prospects for future technical change seem propitious, with continued application of microelectronics, biotechnologies, and other advanced technologies. The rapid pace of technical change in forest products and other industries today suggests that evaluation of distributional impacts of new technologies may take on heightened importance in the future.

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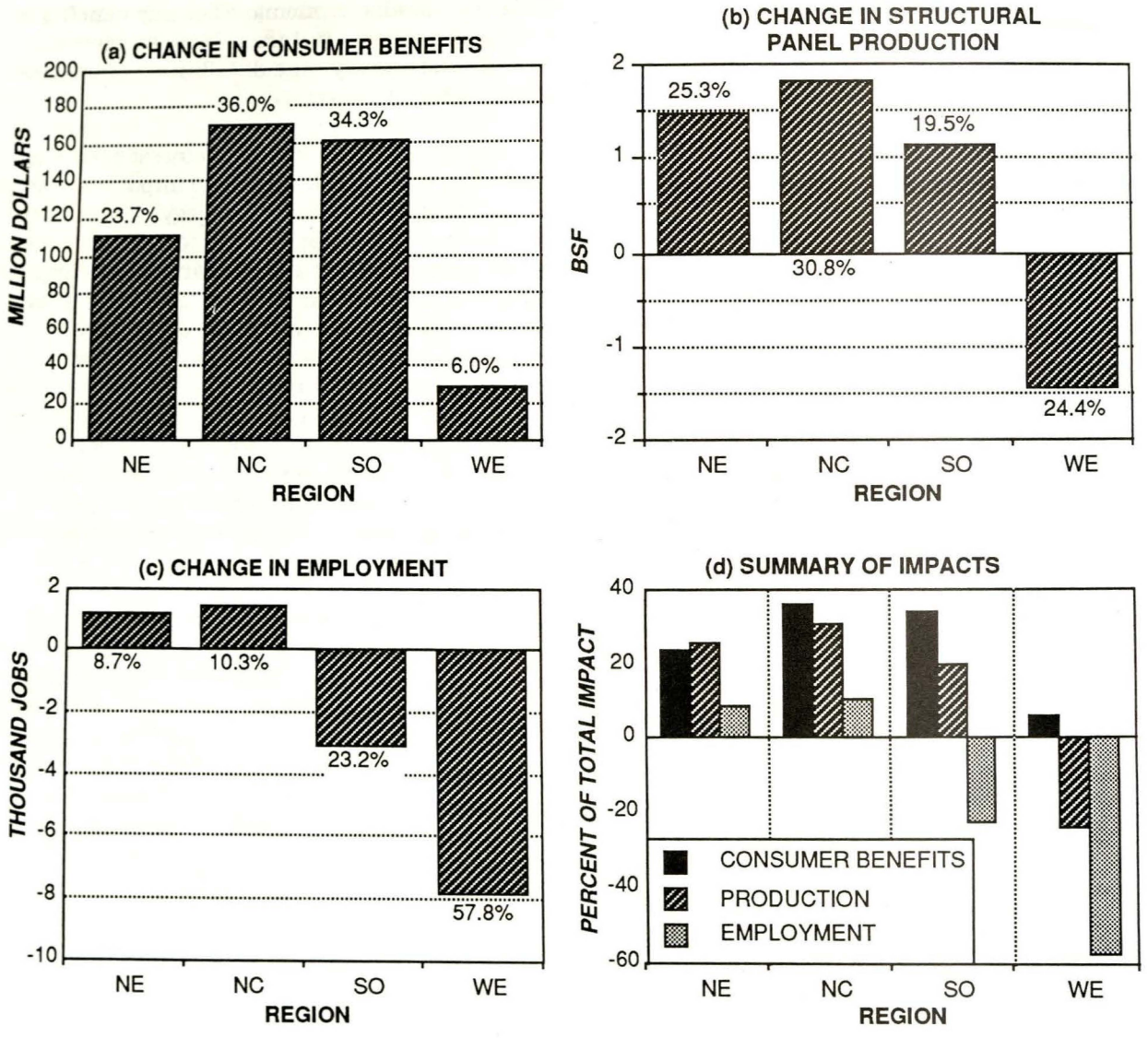

Figure 7.—*Changes in regional impacts resulting from the introduction of structural particleboard (1995 values minus 1980 values).*

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Our job at the North Central Forest Experiment Station is discovering and creating new knowledge and technology in the field of natural resources and conveying this information to the people who can use it. As a new generation of forests emerges in our region, managers are confronted with two unique challenges: (1) Dealing with the great diversity in composition, quality, and ownership of the forests, and (2) Reconciling the conflicting demands of the people who use them. Helping the forest manager meet these challenges while protecting the environment is what research at North Central is all about.